
QATAR NATIONAL MASTER PLAN – A GIS Approach & Experience

by

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ABSTRACT

Urban Planning & Development Authority (UPDA) is spearheading the preparation of a National Master plan for the State of Qatar. As a first priority and as a part of the Qatar National Master Plan, separate yet coordinated master plans for Al Wakra and Al Khor municipalities that include Regional structure plan, Downtown & Waterfront, and District urban design plans are expected early 2008. Strong market forces are currently shaping the physical form of these regions so policies must be developed to implement a cohesive vision of these two municipalities that is consistent with national planning priorities and vision. With recent population and economic growth and further growth expected, the economic climate of the region will continue to drive much of the development.

UPDA is increasingly required to operate with speed and efficiency facing ever more complex political and regulatory issues. GIS technology provides a flexible set of tools to perform the diverse functions of UPDA. Surbana International Consultants Pte.Ltd, Singapore has developed a partial base plan ahead of time and the final base plan is due in early 2008. Base plan constitutes all those data generated as part of this project. Database of these two municipalities is designed in such a way that it will be incorporated with the upcoming database of Qatar National Master Plan by Pacific Consultants International, Tokyo to make one single comprehensive Base plan. It is an attempt by UPDA to successfully perform its duties & functions to serve the public better & efficiently by implementing the master plans through GIS platform.

1.0 INTRODUCTION: GIS approach as a tool for Planning

The planning process deals, in essence, with the management of spatial information for the purpose of supporting the formulation and evaluation of policies on spatial problems, in order to implement plans for the change of spatial structure. A physical planning and the role of the GIS can be divided into

- o Research: refers to the collection of spatial related data and processing, results in a through understanding of processes and phenomena that occurs in society.
- o Design: about the translation of development goals into alternatives for the spatial arrangement of societal phenomena.
- o Policy: weighing and analysis of these alternatives. GIS supports this phase by calculating the effect of decisions.

There is a close link between Planning and Information. Information is needed to assist decision making in planning activities. The monitoring of urban development of Qatar may result in new planning actions. Information is considered as one of the important element of urban planning and activities crucial for the economic, social and environmental advancement of all countries. There have been continuous efforts to improve the database for planning and development by UPDA. Still serious problems regarding availability and organization of data especially are persisting. Geographic information at Planning Department level is used for plan preparation, monitoring & forecasting changes, planning services, managing resources, protecting the public, developing properties, etc.

2.0 BACKGROUND:

Rapid urbanization in Qatar due to various factors led to the idea of Qatar National Master Plan. Within Qatar, Al Wakra and Al Khor are identified as important economic zones brought the demand to plan and develop these two municipalities separately.

The value of urban planning depends upon many things including its timeliness, the context which it is applied and the overall cost of data collection, inventory, presentation, implementation and maintenance. Access to information must be managed and carefully regulated for a successful planning, a continued support and maintenance of the database. Staff and Users need to be encouraged and educated.

2.1 Master Plan Vision & Objectives

With recent population and economic growth and further growth expected, the economic climate of the region will continue to drive much of the development. Other Key objects would be:

- o *to create a new image and long term development direction for the City, anticipate future growth, analyze constraints and opportunities, while ensuring sustainability and meet the residents' aspirations. To achieve the goal, the following objectives are set:*



Figure 1: Map of Qatar showing Al Wakra and Al Khor municipalities

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- *to establish a clear vision, goals, objectives and strategies for the City's development up to year 2032.*
 - *to prepare an implementation plan and a set of monitoring mechanisms to ensure that the City Master Plan will be progressively implemented and that it stays relevant throughout the 25-year period*

The Plans are intended to guide the growth and enhance the quality of life and attract private investment. This proactive approach is essential to ensure that the quality of life that residents have come to know is enhanced and maintained as well.

2.2 The Planning Database:

The demand from different professional experts like Planners, Economists, Ecologists, Engineers etc., for more and combination of land related information was an important motivation to apply technology for having exclusive urban planning database system. They must imbibe an immense amount of information to perform their duties in a fair and sound manner. Users need an accurate, comprehensive and updated base plan to be able to do a thorough analysis and to produce quality output. Analytical GIS systems often have special modules for spatial analysis, geostatistics and spatial modeling. A geographic information system (GIS) provides the data management tools for the planning and spatial data needed to accomplish this task.

One of the key factors for the success of GIS is the database design. Planning department always face restrictions and lack of spatial information. Base Plan constitutes the data derived as part of this project such as Land use, Built mass, Infrastructure, Transportation, Natural environment & issues and etc. To accomplish comprehensive Base plan, an in-depth Gap analysis was performed. Missing data inventory is created. Centre of GIS of Qatar and other agencies have played key role in providing most of the data, Apart of that Consultant has worked hard to collect the missing data and design an exclusive Planning Database for UPDA.

2.3 The Capability:

The definition of GIS lays emphasis on the technical aspects of handling data. The capability to produce maps showing particular combinations of features for selected geographic areas at appropriate scale is one of the technology's most valuable features.

Within the group of urban and regional information systems, a distinction is made between systems that handle technical information and those dealing with socio-economic data. General Survey Department provides useful tools for UPDA. Center for GIS enroutes data from different agencies and updates satellite and aerial photographs as and when required to the users. GIS tends to support analysis, planning and evaluation at a more macro scale. They are used in a variety of contexts to assist the research required to formulate and evaluate central and local government policy with respect to different aspects of physical and environmental planning on the one hand and economic or strategic planning on the other.

2.4 The Elements of Cooperation between Urban Planning and GIS system:

The components need to be in balance, if the system is to function satisfactorily. GIS permit a wide range of operations as well as manipulations on spatial and related attribute data. Maps can be retrieved and updated; analysis by combining maps (overlying technique) can be carried out. Future situations can be analyzed using scenarios. GIS users have many requirements regarding the geographic database. The analytical capabilities of GIS are broadly divided into following categories:

1. Data retrieval, 2. Reclassification, 3. Overlay operation Techniques, 4. Spatial Search operations, 5. Modeling.

Retrieval operations on the spatial and attribute data involve the selection search, manipulation and the output of data without the need to modify the geographic location of features or to create new spatial entities; on the basis of the requirement of the user. Ex: where are the vacant areas within the urban areas? What is the land use in location X and Y.?

Reclassification of original codes into codes for classes suitable, less suitable etc. might help in respect of good areas for urban expansion. Ex: combining diff maps of land use or topography.

Overlay technique is used to create physical suitable homogeneous zones by combining two or more different aspect maps. Ex: land use changes, urban growth direction.

Another special form of overlay is by search operations. Ex: characteristics of the area surrounding a specified location.

A Model is a simplified representation of reality, which presents significant features of relationships in a generalized form. Ex: to analyze the consequences of planning alternatives.

3.0 METHODS: An Experience

At the initiation of the project, it was decided to use GIS as a planning tool that would help to bring out the optimized results leveraging the advantages of spatial data manipulation techniques. GIS will be implemented using ESRI ArcGIS desktop application with a clear and progressive Geodatabase Design.

UPDA and Surbana GIS team together came up with a two-phase implementation model. Phase one would be Urban GIS Data Modeling and coming up with a Comprehensive Geodatabase. Phase two would be building ArcGIS based application to help urban planners to query, Analyze, print and 3D viewing of the urban plans and proposed designs.

3.1 Phase one – Urban GIS data modeling

Taking existing data as input new datasets are modeled, schema is designed based on the planner's day to day needs of data, query requirements, Analysis functions and future extendibility aspects. Iterative process of design is followed to evaluate the business requirements and transform them in to data objects.

3.1.1 Conceptual Framework

Understanding of the data is key for efficient and effective design. Realizing this fact a broad blue print of Master plan creation business is developed. This blue print is the input for analyzing the data requirements.

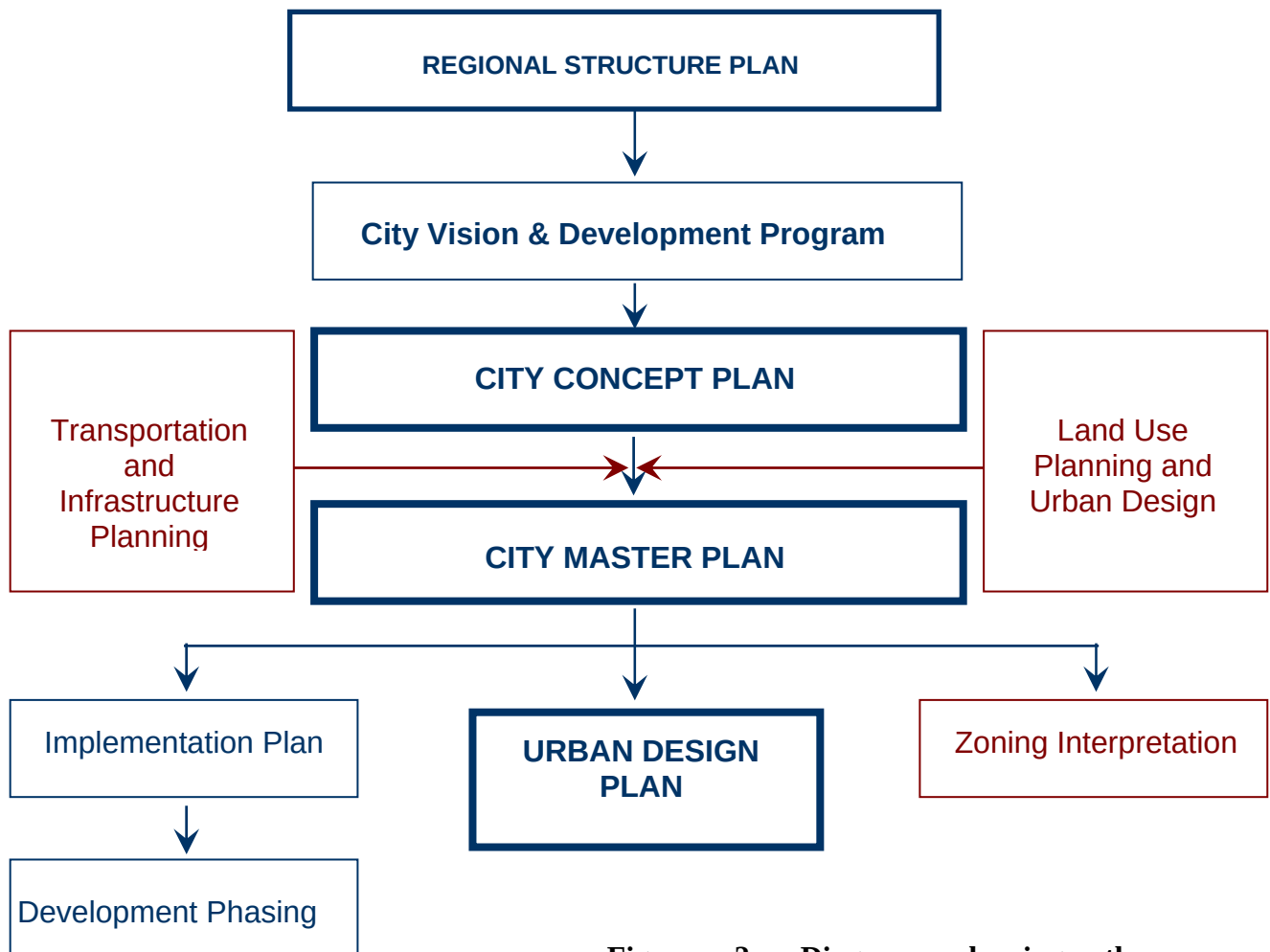


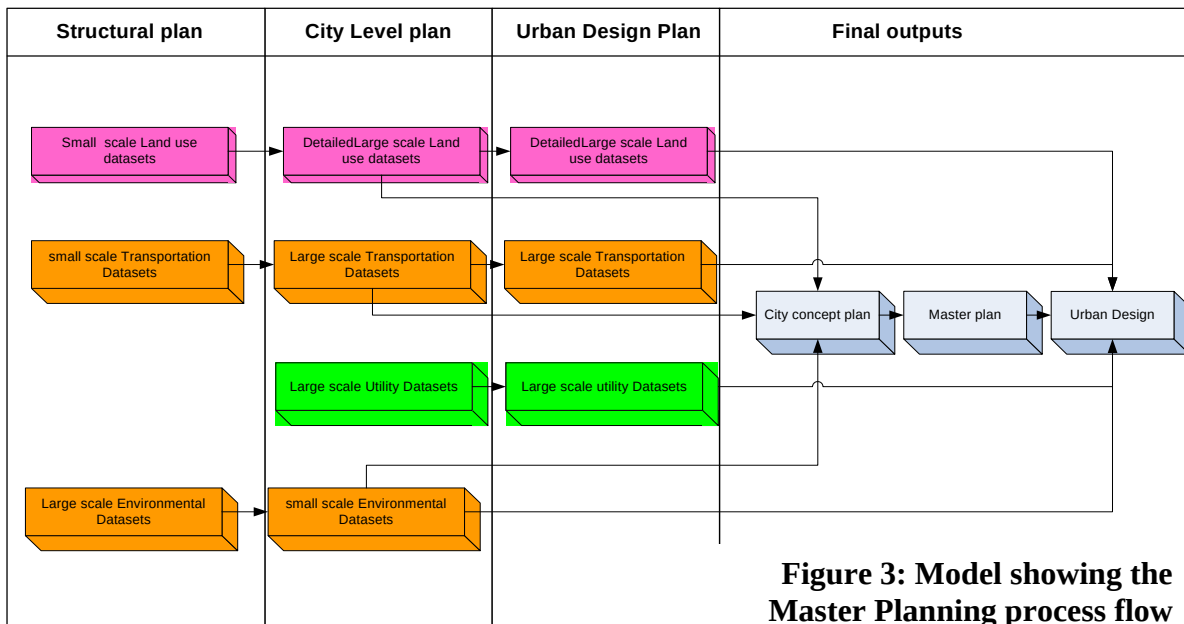
Figure 2: Diagram showing the Conceptual Framework of Master Plan

3.1.2 GIS Database Design for Master Plan

Based on the Conceptual framework, planning process is clear. GIS Analysts and Urban Planners at UPDA and Surbana GIS team worked out a GIS data Model. Each of the Planning phase shall have a different data requirement in different scales. The following requirements are taken into consideration as key design criteria.

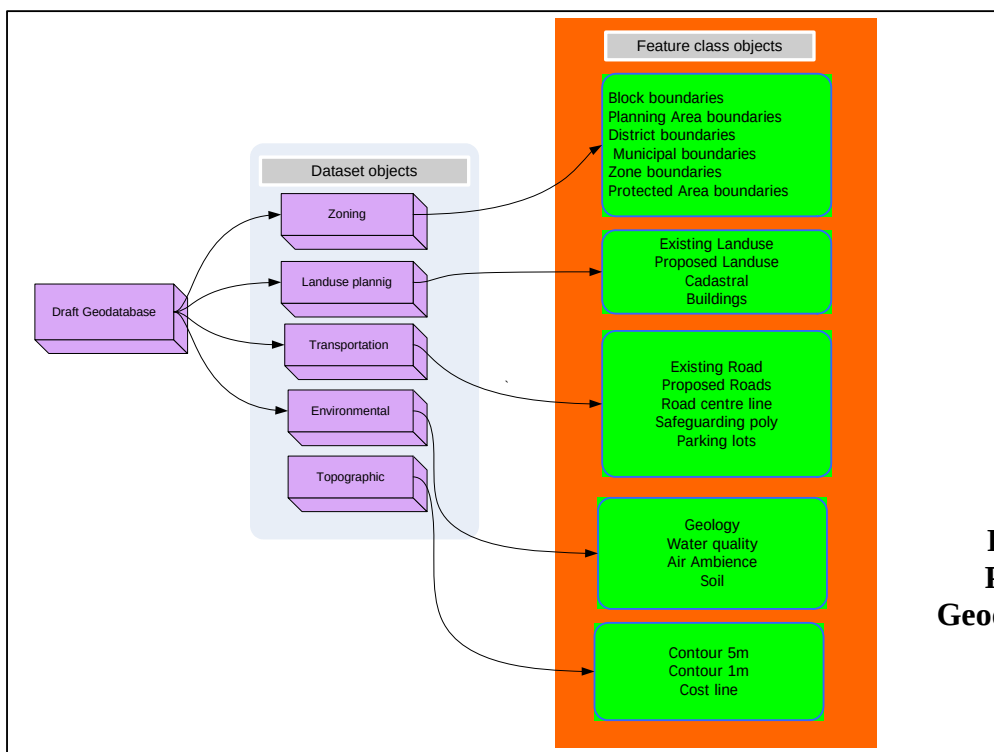
1. Spatial data presentation
2. Administrative Boundaries
3. Data Query
4. Analysis and scenario planning
5. 3D modeling
6. Future Planning Needs

Based on the above criteria the following Master planning process flow is derived. This Model shall give clear idea how datasets and which datasets shall be used for master planning at different stages.



3.1.3 Mapping Requirements to data Objects

GIS data modeling is a process of translation of business needs into Data objects. ESRI Geodatabase provides tools and methods to create such models using interfaces within ArcGIS. This would help the domain experts to get hands on the Data modeling. Success of a design depends on how much percentage of needs are converted into data objects. Geodatabase provides wide range of objects to play around and create data models. Complex custom objects can be created or simple feature class objects can be used. UPDA and Surbana GIS experts and planners together proposed the needed data objects based on the Business requirements. Simplicity and ease of use is on top of the list to consider the alternatives in the model creation. Following is the overview of the proposed Geodatabase.



3.2 Phase Two – Application Design

ArcGIS provides a wealth of Data creation, Analysis and 3D Visualization functions. UPDA and Surbana Management felt that a simple application focusing the immediate and future needs of planners would be more helpful. Brainstorming sessions were conducted; GIS analysts, Urban planners, Environmental experts, Surveyors and Transportation experts discussed, debated and came up with a list of basic needs. This resulted in the GIS functions of view, query, print and analysis.

Overseas Application development team quickly came up graphic screens of the application; this gave visual clarity to the participant teams. Valuable suggestions poured in, with few more rounds of meetings, requirements were clear. Following is the functional and design overview of the Application:

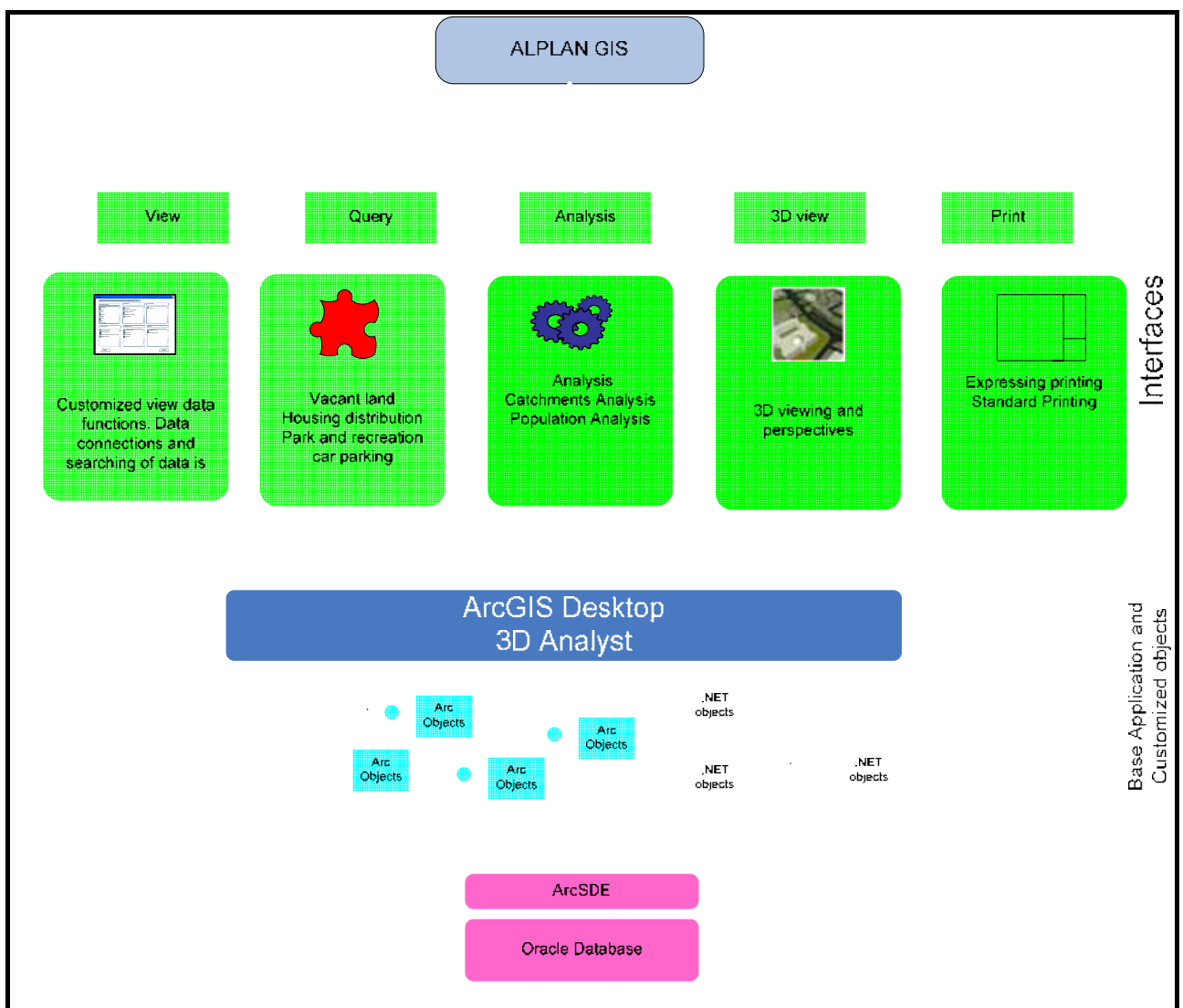


Figure 5: Functional and Design overview of the Application

4.0 CHALLENGES: GIS Technology and Planning Community

Urban planning process is quite complex in nature and involves diversified people and skill sets. Integration of different aspects and perspectives would result in better master plan. Currently majority of the planning processes and their results depend on the interpretations, assumptions that each of the planner make while proposing the different scenarios. No two human beings think alike; henceforth same situations (sites) can be seen by two planners in very different way. But it is needed to have consensus with out compromise on each of the aspect. GIS would be the platform where planning community can leverage on the Technology to enhance their productivity and bring out superior products. UPDA and Surbana together identified the following as the key aspects to overcome the challenges in implementation of Urban GIS technology. Planning department prefers analytical data where as Administrative departments opt for DBMS

5.0 IMPLEMENTATION OF GIS:

The message for municipalities, town planning departments, and development authorities today is that the future is digital. All registers and maps could gradually be stored in digital form. It would be ideal to make these databases available for public as well as institutions. GIS is no more a independent technology. Implementation of a GIS depends on the automation of non-graphical information, specially the financial system. Automation of graphic data does not mean that GIS is implemented. Integration of graphic data and independent automation of non-graphic data makes a better GIS.

6.0 CONCLUSIONS : an Outlook for Future

GIS is a rapidly evolving technology. GIS systems have considerably improved in usability and performance aspects. The high end work stations will boost the GIS efficiency. Processing power, Storage capacities and High-resolution color-graphical output facilities are tend to improve the GIS systems usage considerably. Automation cost would come down. A GUI and object oriented approach to design databases is a key trend in GIS which would allow non-spatial feature objects to link with topological objects of graphical database. This will enhance the sophisticated queries, analysis and modeling based on both values of spatial and attribute characteristics and on relationships of real world objects.

Future is GIS for an efficient planning sequence. For a successful planning and implementation integration of data from various departments as well as clearly defined tasks and responsibilities is necessary. GIS plays a key role in establishing a efficient and well defined semi automated planning

GIS can play an important role in Urban planning and that still some severe limitations exist with respect to the technical functionality of the systems. Hope that these deficiencies would be overcome soon and GIS is well on its way to acquiring the same status with respect to spatial information.



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REFERENCES

- 1 Concepts and Techniques of Geographic Information system by C.P. Lo Albert K. W. Yeung (2002)
3. Decision Support, GIS, and Urban Planning by Michael Batty & Paul J.Densham, Jan 1996
4. Jong, W.M. de (1989); "Uncertainties in Data-Quality and the use of GIS for Planning Purposes", UDMS Conference, Lisbon, Portugal.
5. Remote Sensing and GIS application in Urban and Regional Studies, IIRS, Dehradun, India. (2001)
6. Terms Of Reference - Al Wakra & Al Khor Master plan, UPDA (2006)

